

is desirable. In all cases their use should be combined with the intelligent treatment of the diseased heart, and this can only be done in collaboration with the internist. On his part the internist may find useful in the management of such cases the very special knowledge which the syphilologist has of the various salts of mercury, their different uses in different types of individuals, the advantage of frequent change and more particularly the management of the constitutional side of the infection.

In the employment of newer and more potent arsenic preparations, which are constantly being introduced, I believe it is safe to predict that even greater disaster and more frequent fatality may occur when these drugs are used in the treatment of the visceral forms of the disease. The syphilized liver and heart, in whatever stage of the disease, from clinical experience at least, seem to do better when the process of repair is slow and when no great strain is placed upon their normal functioning activities.

### ACUTE LUNG ABSCESS TREATED BY THERAPEUTIC PNEUMOTHORAX.

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THE danger and the high mortality of surgical drainage of pulmonary abscess lend importance to the discussion of any method which will improve our results in these cases. It has seemed worth while, therefore, to report the following experiences with the hope that as case-records accumulate we shall be able to steer a safe course in the treatment of acute pulmonary abscess. The cases here reported are all non-tuberculous.

**Nomenclature.** The term lung abscess is a somewhat ill-defined expression for intrapulmonary pus. It may be diffuse or circumscribed, acute or chronic, gangrenous or not. It is frequently an extension from a purulent process in the neighboring tissues, as empyema, lateral or interlobar. Its etiology has many items. For the purpose of this paper, pus in the lung, the result of burrowing from an interlobar empyema, ultimately reaching a bronchus, is called a lung abscess. There seems to be no single pathologic term in English which will describe this condition. Other processes producing free pus in the lung are included under this term, the etiologic items being mentioned in the separate case reports. This explanatory paragraph is inserted because of the lack of satisfactory nomenclature for these conditions, causing confusion in the mind of the reader.

CASE REPORTS. CASE I.—Miss B., stenographer, aged twenty-one years. Bronchopneumonia. Lung abscess. Pneumothorax successful. Recovery.

First seen October 16, 1919. Had been ill with bronchopneumonia six weeks; fever, chills, pain in right chest until it "broke." For one week there had been daily evacuation up to one pint of pus, extremely foul smelling. Temperature, range 101° to 104° F. Great prostration and weakness. Physical findings showed impaired resonance over the lower lobe right lung, surrounded by zone of moist rales of great variety. No signs of fluid or tuberculosis. Diagnosis of lung abscess or interlobar empyema was made and compression of the lung by means of therapeutic pneumothorax advised.

Entered Harper Hospital, Detroit, October 21. Temperature, 102° to 104° F. Weight, 84 pounds (usual weight, 96 pounds).

October 24. Pneumothorax attempted in fifth interspace of the right axilla. Pleura very thick; strong pleural reflex with severe pain; 50 cc sterile air injected, but was obliged to discontinue because of spasm of diaphragm due to pleural reflex.

October 25. Pneumothorax in third interspace; 300 cc air introduced. Followed by only slight pain, but in a few hours by greatly increased cough and expectoration. Seemed much better two days later, but foul sputum continued in small quantity.

October 30. 250 cc of sterile air.

November 6. 300 cc of sterile air followed by some pain at the base of the right lung. Cough and expectoration disappeared.

November 9. Patient left hospital apparently well. Weight, 90 pounds. Sputum repeatedly negative for tubercle bacilli. Frequent reports from the patient since up to June, 1921: Has remained in good health and without cough or expectoration.

CASE II.—A. S., lawyer, aged forty-eight years. Simple cold followed by lung abscess. Successful pneumothorax. Recovery.

Never ill in bed since infancy.

October 23. Had cold. October 25. Went to Oklahoma. Had fever, chills, bad cough, sputum became purulent about November 2. First seen November 6. Temperature, 100.8° F. Paroxysmal cough, odor of sputum extremely foul. Physical examination showed an impaired resonance and bronchial breathing in the right axilla, at 4th and 5th ribs, surrounded by a zone of coarse and fine moist rales. Sputum negative for tubercle bacilli.

Entered Harper Hospital November 12. Temperature, 101° F. Roentgen ray. "Fluoroscopic examination: Chest in erect position shows abscess described previously in the right upper lobe. There is definite evidence of cavity formation. The right upper lobe is apparently immobile. Free excursion of diaphragm on both sides." (Allison)

Pneumothorax, anterior axillary line, in 4th interspace; 275 cc of sterile air introduced.

About twenty-four hours later the patient had a severe paroxysm of coughing, with evacuation of a large quantity of sputum and alarming exhaustion. This was the last of the severe paroxysms of cough.

November 14. Pneumothorax attempted. Slight pleural shock from the needle used in giving local anesthetic. No gas given.

Patient continues to improve. Temperature not above normal after November 19. Left hospital November 28. Entirely free from symptoms; last seen June, 1921.

This was a case of interlobar empyema, opening into a bronchus, following a simple cold. Nothing else so far as I know can answer the roentgen-ray description of a cavity partly filled with fluid, later disappearing entirely. Evacuation was induced by very slight compression and recovery was prompt and satisfactory.

CASE III.—Miss K., aged nineteen years. Appendectomy with drainage. Influenza. Bilateral bronchopneumonia. Lung abscess. Pneumothorax successful. Death.

Never ill in bed until January 10, 1920. Acute suppurative appendicitis; operated in local hospital; drainage established.

January 25. Said to have had influenza followed by double bronchopneumonia. Temperature normal in ten days, then chill, fever, pain in region at base of right lung. First seen February 22. Temperature, 104° F. Patient emaciated, pale, panting, anxious, very weak, pulse 140. Open wound in abdomen with foul discharge. Exhausting paroxysmal cough, raising at intervals 4 to 6 ounces of sputum, extremely foul odor. Examination of chest: Relative dullness in irregular area of lower right lung. Many coarse, moist, bubbling rales. No evidence of fluid.

Entered Harper Hospital, February 24. Temperature, 101.4° F. Pulse, 132. Symptoms and signs unchanged. Sputum, negative for tubercle bacilli; pneumococcus, Type IV.

March 1. Symptoms continued without improvement, so compression was undertaken as a last resort. Pneumothorax needle introduced in 4th intercostal space of right anterior axillary line. Pleura thickened; no oscillation; in third intercostal space, good oscillation and 350 cc of sterile air introduced. Later, coughed up several ounces of foul sputum. Felt relieved and coughed much less until death the following day from asthenia. No autopsy permitted.

It is obvious that the fatality in this case was not due entirely to the lung abscess nor to the pneumothorax.

CASE IV.—Mrs. T., aged thirty-one years; pregnant five months; influenza. Interlobar empyema; evacuation into bronchus; successful pneumothorax; recovery.

Seen February 16, with recurrent paroxysmal cough and great expectoration of five weeks' duration following influenza; pregnant five months; paroxysm very severe, leaving patient exhausted, limp and expecting to die. Previous history unimportant. Signs of abscess in lower lobe right lung.

= Entered Harper Hospital February 16. Temperature, 103° F. Pulse, 120. Urine negative. Sputum negative for tubercle bacilli. Pneumococcus, Type IV. Blood: 16,000 white cells, polynuclears, 52 per cent. Patient did not improve.

February 18. Pneumothorax needle inserted in midaxillary line, 4th intercostal space. Gave 550 cc of sterile air. Very severe paroxysm of coughing about six hours after first injection of air. Emptied out a pint of purulent fluid. Much relieved. Temperature reached normal four days later. Never had severe cough after that day. Second injection in seven days, February 25. Left hospital March 3, free from symptoms.

June, 1921, reported quite well by family physician, never having had any return of symptoms.

In this case the pathology was probably an interlobar empyema burrowing into the lung.

CASE V.—Mrs. P., aged thirty-one years. Influenza; pneumonia; lung abscess in upper lobe. Spontaneous recovery.

Two children. Never ill since childhood until influenza in January, 1920. Pneumonia followed. First seen three weeks later, February 10. Terrific paroxysms of coughing with large quantities of fluid, offensive pus. Signs of interlobar empyema, probably between upper and middle lobes on right.

No roentgen-ray taken then. Patient reluctant to go to hospital and a few days later began to improve and ultimately recovered. Roentgen-ray six weeks later showed most of lung clear, the only signs of the recent trouble being increased linear markings in the right lung.

June, 1920. In good health.

This was an instance of so-called spontaneous recovery.

CASE VI.—Miss D., aged twenty-nine years. Similar to Case V. Social worker, never ill before. Seen February 15, 1920. Paroxysmal cough, bringing up at times more than a teacupful of purulent sputum. Sputum had pinkish tint. Temperature, 102.8° F. Profuse sweats. Profound exhaustion. Refused hospital. Gradual improvement. Left city several weeks later, in good condition.

Another spontaneous recovery.

CASE VII.—A. F. aged forty-two years. Mechanic. Bronchopneumonia followed by lung abscess. Successful pneumothorax. Recovery.

Entered Harper Hospital, service of Dr. Freund, April 4, 1920. Complaint—fever, cough with blood-tinged sputum, dyspnea, weakness. Previous history negative. His symptoms have been gradually developing for ten days. Physical examination showed extensive pyorrhea and many crowned teeth which later proved to cover five dental abscesses, one very large. There was dullness over the upper half of the right chest and in the upper axilla. Whispered voice increased over a part of this area. Breath sounds were variable, distant in some areas with bronchovesicular predominant. Fine and coarse rales. Temperature range, 101° to 103° F. Wassermann negative. Temperature down to normal on sixth day with 101° F. in evening. Continued to have 99° to 103° F. daily. Sputum negative for tubercle bacilli; pneumococcus, Type IV. Symptoms continuing and patient becoming weaker. On May 20, therapeutic pneumothorax was induced. Puncture in 8th intercostal space below point of scapula. 550 cc of sterile air given.

May 23, 200 cc of sterile air were given. Patient improved promptly. Temperature approached normal; cough and expectoration less; appetite and strength improved.

May 29. Roentgen ray report: "Outer fourth of upper right lung filled with an area of density, extending toward the midlung field, opposite to the third interspace. There is evidence of a partial collapse of the lung, the extra density is probably due to thickening of the pleura." W. A. Evans.

June 3. 200 cc of sterile air injected.

June 12. Patient discharged from hospital, apparently well. Seen on August 1 and had continued to that time without symptoms. Had gained 42 pounds.

The sequence in this case was undoubtedly first multiple dental abscesses; second, lobar pneumonia; third, lung abscess.

CASE VIII.—Mrs. C., aged twenty-eight years; pregnant seven months. Influenza. Lung abscess. Compression successful. Recovery.

February, 1920. Influenza, followed by lung abscess in left lower back. First seen March 12. Had been ill six weeks. Daily evacuation of twelve to fifteen ounces of foul pus; very weak; no fever. Also pregnant and fearing miscarriage from cough. Usual signs of abscess. Had had three "dry" punctures. Pneumothorax with 500 cc of air injected on March 13. By March 17 the twenty-four hour amount of sputum was reduced to five ounces. On March 18 there was none. Practically no cough after this. Patient left hospital on March 21, and resumed household duties.

March 30, 500 cc of air given. Has remained well since and been successfully confined.

CASE IX.—Mrs. P., aged thirty years; operation on cervix; lung abscess; unsuccessful attempt at pneumothorax; surgical drainage; death.

Had two children. Never ill. Was operated for laceration of cervix, leaving hospital July 24, 1920, convalescent. One week later pain in lower right chest; sudden onset. Respiration painful. Temperature, 103°F. Marked dyspnea. After continued fever for six days the temperature dropped and a pint of blood-stained, foul-smelling purulent sputum was expectorated. Two days later fever again appeared and septic temperature continued until first seen with Dr. George E. McKean, August 26. At this time she had physical signs of an abscess of lung under right breast. Roentgen-ray showed a fluid level, the lateral oblique plate showing that the abscess anteriorly was very near the external pleura.

August 28. Therapeutic pneumothorax in the fourth intercostal space, midaxillary line, 500 cc of sterile air injected. Pleura distinctly thickened. Violent coughing following with considerable subcutaneous emphysema. During the following twenty-four hours the abscess perforated into the pleural cavity under the right breast. The condition was then complicated by this pyopneumothorax, which was operated under local anesthesia by Dr. Max Ballin, August 29. Ample drainage was established, but the patient did not rally and died August 31 from pulmonary edema.

In this case there was a septic embolus from the cervix. The abscess was near the periphery of the lung. To attempt pneumothorax in such a case is undoubtedly a mistake.

CASE X.—Mrs. B., aged twenty-five years. Tonsillectomy; lung abscess for five months. Pneumothorax successful. Recovery.

Tonsillectomy in December, 1916. Four days later had pneumonia, lasting two weeks. Shortly after began expectoration of foul-smelling, purulent sputum. Had cough, pain, sputum, occasionally bloodstreaked. Coughed more on first rising in morning; also when lying on right side. This continued all winter. Was slightly better in summer, but symptoms reappeared in the fall, 1917. Went to California, January to March, 1918. Seen first after return. Temperature, 100.6°; pulse 120, sitting; weight, 203 pounds. Complaint, pain in right upper thorax; night-sweats, cough and foul sputum continue.

May 27, 1918, therapeutic pneumothorax induced by 300 cc of nitrogen in the right pleural cavity. Was followed by severe pain for one day. No increase in amount of sputum.

June 4. 550 cc of sterile air. Had considerable pain and some subcutaneous emphysema.

June 20. No fever, cough or foul sputum since last injection.

Gave 400 cc of sterile air. Had pain in back and neck for one day. No more night-sweats.

This was the last treatment. Symptoms disappeared and there has been no reappearance up to December, 1920.

This abscess could hardly be called acute, and compression was obviously imperfect, owing to adhesions. It shows that the pneumothorax method may be useful even in the presence of adhesions, and that complete collapse of the lung is not necessary in every case.

**Spontaneous Cure.** It should be pointed out that a certain number of cases of pulmonary abscess empty out through a bronchus and recover perfectly. I have seen 3 such cases, and the medical profession of nearly every community has traditions of such happy cures. In 1 case, which I studied three years after such spontaneous evacuation, neither physical examination nor roentgen ray revealed any evidence of permanent change in the lung. This abscess followed a tonsillectomy and had been active four weeks. The spontaneous evacuation occurred one hour before the operation for surgical drainage was to be done.

In the 3 cases of spontaneous cure here noted the abscess in each case was in an upper lobe. It seems certain that spontaneous cure is much less likely to occur when the lesion is in a lower lobe. While these do often discharge into a bronchus, their evacuation is usually only partial and the coughing necessary is so severe and exhausting as to be highly alarming. The inverted posture assists the cough in emptying the contents of the abscess, but in the event of a tortuous fistulous track does not help greatly. In the present series of cases inversion of the person was only occasionally useful.

It would seem then that while upper lobe abscesses may be spontaneously cured it is highly improbable that those in the lower lobe will. It is extremely important that one should not be misled in prognosis by the fact that a lower lobe abscess is discharging pus through a bronchus. This does not mean that efficient drainage is established, and while waiting for spontaneous cure one may allow the time to pass in which the lung could be successfully compressed and a perfect cure effected.

**Time for Operation.** In this series the oldest abscess successfully treated was of eight weeks' standing with the exception of Case X.

In Tewksbury's series of 10 acute cases the latest successful one was of six weeks duration. The most advantageous time would seem to be between the second and fourth weeks. The development of adhesions to the outer chest wall will depend largely on the position of the abscess. When near the periphery, adhesions will quickly form and perforation into the external pleural cavity is the event to be expected. It is doubtful if compression should

be undertaken in these cases. On the other hand abscesses near the hilus, where most difficult to reach for surgical drainage and where bronchial fistulæ are most likely to persist, are easily and promptly cured by a mild compression. Since the therapeutic pneumothorax is painless and harmless the question arises whether one is ever justified in carrying expectant treatment more than two weeks.

One factor which must be insisted upon is the continuance of the treatment until the lesion has had time to heal. While a short compression may be followed by the most happy results, one should maintain the compression for four weeks in acute cases and much longer in chronic cases. Such chronic cases, however, may safely leave the hospital in a few days, doing light work and merely returning at regular intervals for refills.

**Etiology.** Of the 10 cases here cited:

One followed a pelvic operation, the colon bacillus predominating in the lung abscess, undoubtedly a septic infarct.

One followed a simple cold.

One followed tonsillectomy under ether anesthesia.

Two followed bronchopneumonia.

Four followed the influenza-bronchopneumonia syndrome. In several of these cases the roentgen-ray findings made it certain that interlobar empyema preceded the abscess formation.

Eight of the 10 cases were women; 2 men. All were adults twenty-one to forty-eight years. None of these gave a history of previous lung disease. In fact, in none of these patients was there any history of previous severe illness of any character. Repeated examinations for tubercle bacilli were made in every case, and all were negative.

The time of development varied greatly. In Case II, a simple cold developed fetid sputum in five days. Two cases of bronchopneumonia "broke" in about six weeks. The lung infarct following operation on the cervix, developed two weeks after operation (Case IX). In none of the influenza cases could the time be accurately fixed. In each of these symptoms ultimately showing abscess developed about three weeks after the onset of the pneumonia.

**Prognosis.** Under the older methods of treatment the outlook for a case of pulmonary abscess is indeed discouraging. Spontaneous recovery is very uncertain and is not due to any treatment. Forchheimer quotes the figures on 133 cases with less than 10 per cent recovery and death in 64 per cent. Other figures are more favorable for small numbers of cases. However, the surgical treatment involves a highly difficult and dangerous operation, and Lord makes the statement that "incomplete cure is the rule." Combining the cases reported by Tewksbury with those here detailed, there are 20 cases of acute abscess with 16 instances of prompt and complete recovery, or 80 per cent.



**Comment.** The literature on this form of treatment in abscess is limited. The procedure was first proposed by Forlanini, and later, 1910, he reported a case of chronic lung abscess of six years' duration following croupous pneumonia. Treatment was continued twenty-five months with great amelioration of symptoms. He does not record the treatment of any cases of acute abscess, but Schmidt, in 1908, in reporting experience with pneumothorax in a variety of conditions, mentions its use in three cases as follows:

1. "Aspiration-pneumonia," six months' duration. One injection of 1000 cc of sterile air. Much better in two weeks; discharged from hospital cured in four weeks.

2. "Fetid bronchitis," several years' standing, worse last few weeks. No response to previous treatment. Tubercle bacilli present in sputum. Prompt improvement under treatment, which consisted of one injection of 300 cc of sterile salt solution. Patient gained eighteen pounds in five weeks. Discharged cured. Seen two years later with no return of symptoms.

3. "Fetid bronchitis," with induration in right lower lobe. Had been ill without improvement from September to February (five months). One injection of 1200 cc of sterile air. Patient left hospital in one month, apparently well, seen thirteen months later, no recurrence.

Whether these cases should be classed as bronchiectasis or lung abscess is difficult to say. The report of cure by a single injection, one by the use of salt solution, is at least interesting and stimulating.

Tewksbury in two papers reports in all 10 acute cases with 8 recoveries and 2 deaths. In the fatal cases the compression was not directly connected with the cause of death, as both cases had serious disease aside from the lung abscess.

**Summary.**—Ten cases of pulmonary abscess are reported. Eight were treated with therapeutic pneumothorax. There were 8 complete recoveries and two deaths—two spontaneous recoveries.

The experiences here related corroborate those of Tewksbury in every particular. Acute pulmonary abscess may be promptly and completely cured by therapeutic pneumothorax. A possible exception should be made in those cases where the abscess is located near the periphery of the lung.

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